Research Report 1815

Training Future Force Leaders to Make Decisions Using Digital Information

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Micro Analysis & Design, Inc.

December 2003

United States Army Research Institute for the Behavioral and Social Sciences

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20040206 077

U.S. ARMY RESEARCH INSTITUTE
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A DIRECTORATE OF THE U.S. ARMY HUMAN RESOURCES COMMAND

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Research accomplished under contract
for the Department of the Army

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REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
December 2003	Final	January – November 2003

4. TITLE AND SUBTITLE
Training Future Force Leaders to Make Decisions Using Digital Information

5a. CONTRACT OR GRANT NUMBER
DASW01-03-C-0016

5b. PROGRAM ELEMENT NUMBER
665502

6. AUTHOR(S)
Rick Archer, Walter Warwick, Patricia McDermott, and Josh Katz (Micro Analysis and Design, Inc.)

5c. PROJECT NUMBER
M770

5d. TASK NUMBER

5e. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Micro Analysis and Design, Inc.
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Research Institute for the Behavioral and Social Sciences
Attn: DAPE-ARI-IJ
5001 Eisenhower Ave
Alexandria, VA 22304-4841

10. MONITOR ACRONYM
ARI

11. MONITOR REPORT NUMBER
Research Report 1815

12. DISTRIBUTION/AVAILABILITY STATEMENT
With permission of the performing organization, approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Richard E. Christ, Contracting Officer's Representative

14. ABSTRACT *(Maximum 200 words)*: This report was developed under a Small Business Innovation Research (SBIR) Program, Phase I. The research sought to understand differences in decision making between traditional Infantry operations and Objective Force Warrior (OFW) operations. In OFW, digital information such as video sensors and detailed map overlays will replace probabilistic cues from the environment. The question was whether and how digital information will change the way decisions are made and information is processed. Naturalistic Decision Making methodologies were used to understand the cognitive requirements of both types of operations. While the decisions themselves do not differ, the decision-making process and the information used are different with digital information than with traditional cues. Decision making with digital informatio n is more analytical and the OFW small unit leader must be trained to maintain coherence in order to get an accurate picture of the mission environment. There are additional steps of data analysis and data fusion because the digital information is not from the leader's own perception. Spatial orientation will become a key issue and skill in the electronic battlefield. This understanding of the decision process in the electronic battlefield was used to develop training requirements and a replicable methodology for addressing the training challenges.

15. SUBJECT TERMS
Objective Force Warrior, Digital Training, Computer-Based Decision Making, SBIR Phase I Report

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	44	Richard E. Christ 706-545-2207

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December 2003

Army Project Number 665502M770 | **Small Business Innovation Research**

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FOREWORD

The Infantry Forces Research Unit of the U. S. Army Research Institute for the Behavioral and Social Sciences conducts research under a Science and Technology Objective, *Training Objective Force Small Unit Leaders and Teams.* One goal of that research is to develop training methods that will permit small unit leaders to exploit the opportunities made possible by emerging information technologies. A major challenge to this research is that while the new technological concepts are in development, the systems themselves will not be fielded for several years. What is needed are methods to forecast how the processes for handling information and making decisions will be impacted by the technologies, and to link these changes to appropriate training strategies.

The present report describes the approach and results of an Army Phase I Small Business Innovation Research (SBIR) project that addressed these needs. The authors reviewed information available from the designers of the new technologies and used cognitive task analysis to develop an understanding of the cognitive requirements for using the technologies. Based on this understanding of the cognitive skills needed to successfully use the technologies, the requirements and objectives for a replicable computer-based training methodology were developed to address the resulting training challenges.

The results of the research have been discussed with personnel from the Dismounted Battlespace Battle Lab and the Directorate of Operations and Training at the U.S. Army Infantry School. These results and those expected from a follow on Phase II SBIR effort will serve as the basis for developing the proposed training methodology and for insuring the Objective Force Warrior community has input to and a sense of ownership for the research products.

Franklin L. Moses
Acting Technical Director

TRAINING FUTURE FORCE LEADERS TO MAKE DECISIONS USING DIGITAL INFORMATION

EXECUTIVE SUMMARY

Research Requirement:

The goals of this effort were twofold. The first was to understand the differences in decision-making between traditional Infantry operations and Objective Force Warrior (OFW) operations. In OFW, digital information such as video sensors and detailed map overlays will replace uncertain cues interpreted from the environment. The question was whether and how digital information will change the way decisions are made and information is processed. Once these differences were understood, the second goal was to determine implications for training. The following research objectives were addressed in the project:

- Understand the decision requirements for the dismounted Infantry leader
- Compare and contrast the processes of information gathering and decision making for the dismounted Infantry leader in conventional and digital environments
- Link the decision processes in a digital environment to training strategies for the dismounted Infantry leader
- Define and document a computer-based training methodology for envisioned OFW systems

Procedure:

The research methodologies were grounded in the Naturalistic Decision Making paradigm for researching decision making in action. Data were collected via interviews, OFW planning materials, and literature review. Cognitive Task Analysis interviews were conducted with both an Infantry expert and an OFW designer to understand the cognitive requirements and information available in both traditional and OFW Infantry operations. Training and skill requirements from the lead technology integrator for OFW were reviewed to understand the needs addressed. A literature review was conducted to understand the effects of digital information in aviation. The collected data were reviewed to understand the key differences between conventional and electronic decision requirements. This information was used to specify the requirements and objectives of a tool to help leaders adjust to digital information fusion and use.

Findings:

For the most part, the decisions that a small unit Infantry leader needs to make on the battlefield are the same whether he is using conventional techniques or envisioned electronic information technologies. However, the process that the decision maker uses to make the decision and the accuracy of the information used are very different. If the leader has electronic information about the situation he is entering, he needs to be much more analytical in his

approach to decision making. The OFW small unit leader must be trained to maintain coherence in order to get an accurate picture of the battlefield or other mission environment. Even reading a map requires more analytical thought than perceiving the environment first hand. *The difference is not so much that it is digital or that it is certain, the main difference is that it requires an additional step of data analysis and fusion because information is not from the leader's own perception.* Spatial orientation will become a key issue and skill in the electronic battlefield. The OFW leader will need to understand the data being sent to him from the sensor's point of view and then translate that into information that he can use to make a correct decision. Training will be crucial to help the leader take advantage of the new information provided to him rather than being confused or misled by it.

Utilization of Findings:

These initial findings about decision processes in the electronic battlefield were used to develop training requirements and a replicable methodology for addressing different types of battlefield information. A tool is needed to help Infantry leaders gain competence in data fusion and spatial orientation. Ideally, this training will be modeled after field training exercises and the feedback elicited during after action reviews. The tool should present decision options to the trainee that are dependent on his successful interpretation of disparate sensor data and other information sources. The tool should be authorable and easy to use so that training developers and unit commanders can quickly develop training scenarios. There should be a library of scenarios and feedback available to the OFW community. A computer-based tool that meets these requirements will ease the adjustment of leaders to digital information and help them become more competent at using and interpreting the information appropriately. By simulating the planning that occurs after receiving an operations order and the execution of those plans, and by providing the trainee with feedback that occurs during after action reviews, the tool could provide unlimited realistic experiences that can be embedded in the leaders' planned personal computing equipment. The advantage over existing training scenarios is the addition and emphasis on integrating electronic sensor information as cues.

TRAINING FUTURE FORCE LEADERS TO MAKE DECISIONS USING DIGITAL INFORMATION

CONTENTS

LIST OF FIGURES

TRAINING FUTURE FORCE LEADERS TO MAKE DECISIONS USING DIGITAL INFORMATION

INTRODUCTION

The Objective Force Warrior (OFW) program will produce capabilities for dismounted Infantry leaders that will give them tremendous advantages over their adversaries in future wars as well as in other missions that the military may be asked to perform.[1] However, the skills that OFW leaders will need to take advantage of these new capabilities differ significantly from those required by today's leader. This will put a tremendous burden on training developers to prepare leaders for the new environment in which they will be expected to perform. In addition, although the concepts for the new technologies are currently being developed, the systems themselves will not be fielded for several years. As a result, it is impossible to know what a capability will look like in the hands of the OFW leader or exactly how it will work. This situation presents a challenge to develop training at the same time as the new systems are being developed. This is especially true with regard to the information that will be available to the OFW leader. Digital technologies will provide information that is potentially more varied and more certain than the information the leader has had to consider in the past. This, in turn, will place new and different demands on the ability of leaders to fuse information and understand his situation.

The present effort focused on identifying the new demands imposed on the leader by new digital technologies and developing methods to train small unit leaders to use these technologies to make critical decisions. There were four primary objectives for this effort:

- Understand the decision requirements for the dismounted Infantry leader
- Compare and contrast the processes of information gathering and decision making for the dismounted Infantry leader in conventional and digital environments
- Link the decision processes in a digital environment to training strategies for the dismounted Infantry leader
- Define and document a computer-based training methodology for envisioned OFW systems

METHODS

The methods we used to address our objectives can be described as four basic tasks. These tasks are described in subsequent sections.

Identify Realistic Candidate OFW Tasks and Technologies

The first task was to identify realistic candidate OFW tasks and enabling technologies for which decision training will be needed. The following information was collected during a series

[1] A formal introduction to the OFW program and a list of pertinent reference documents can be obtained from the following web site: http://www.natick.army.mil/Leader/WSIT/index.htm.

of personal communications with personnel associated with the lead technology integrator for OFW: a decomposition of generic tasks by mission type, a matrix of critical tasks by information technology, a matrix of critical tasks by user, and a description of human-machine interface concepts including input to and output from the leader. Familiarization with this information enabled us to develop realistic scenarios and probes for data collection with subject matter experts (SMEs). A key realization was that most information would not be accessible or used while a leader is actively engaged in a mission (e.g., while a leader is navigating terrain, engaging the enemy, and evacuating casualties). However, digital information will be invaluable during planning because it will provide information that is more detailed and more certain than information currently available. Digital information will also be available during pauses in execution. These are points during which there is a break in the action and the leader has a few moments to collect and utilize additional information. For example, a small unit leader who has just reached the tree line before a village might look for hostile threats before approaching a building. Another example is a leader who takes cover behind a building, but before entering it, takes a moment to scan for signs of enemy in an adjacent building.

Understand the Cognitive Requirements of Using OFW Technologies

The next basic task dealt with understanding the cognitive requirements (e.g., decisions, information sources, how information is used, strategies, context, constraints, challenges) of using OFW technology to conduct Infantry operations. Because the technology does not exist and there are no users, we conducted interviews from three different perspectives to "triangulate" the cognitive requirements (please see Figure 1). The interviews used Cognitive Task Analysis techniques to go beyond the procedures and textbook knowledge that are represented in a traditional task analysis (Chipman, Schraagen, & Shalin, 2000). Cognitive Task Analysis allowed us to "get inside the heads of experts" (Phillips, McDermott, Thordsen, McCloskey, & Klein, 1998) and understand general and specific knowledge about a particular task. This included the judgments, decisions, problem solving skills, and expertise that are critical to success.

We first interviewed a designer of OFW technology in order to understand the technology that will be available to the OFW leader and how it will be used. This interview provided background information on OFW technology and provided insight about requirements toward which the developers were working. During the interview, a Scenario Walk-Through was used. The designer walked through an OFW urban Infantry scenario and filled in missing pieces such as the types of decisions made, the information available, how the information was used, communications, and likely actions. This was followed with other questions such as: What is the likelihood of having that information? What is the certainty of the information? What other information would you like to be able to provide him? What information will be missing? What is his biggest challenge at this point? How do you expect the small unit leader to proceed?

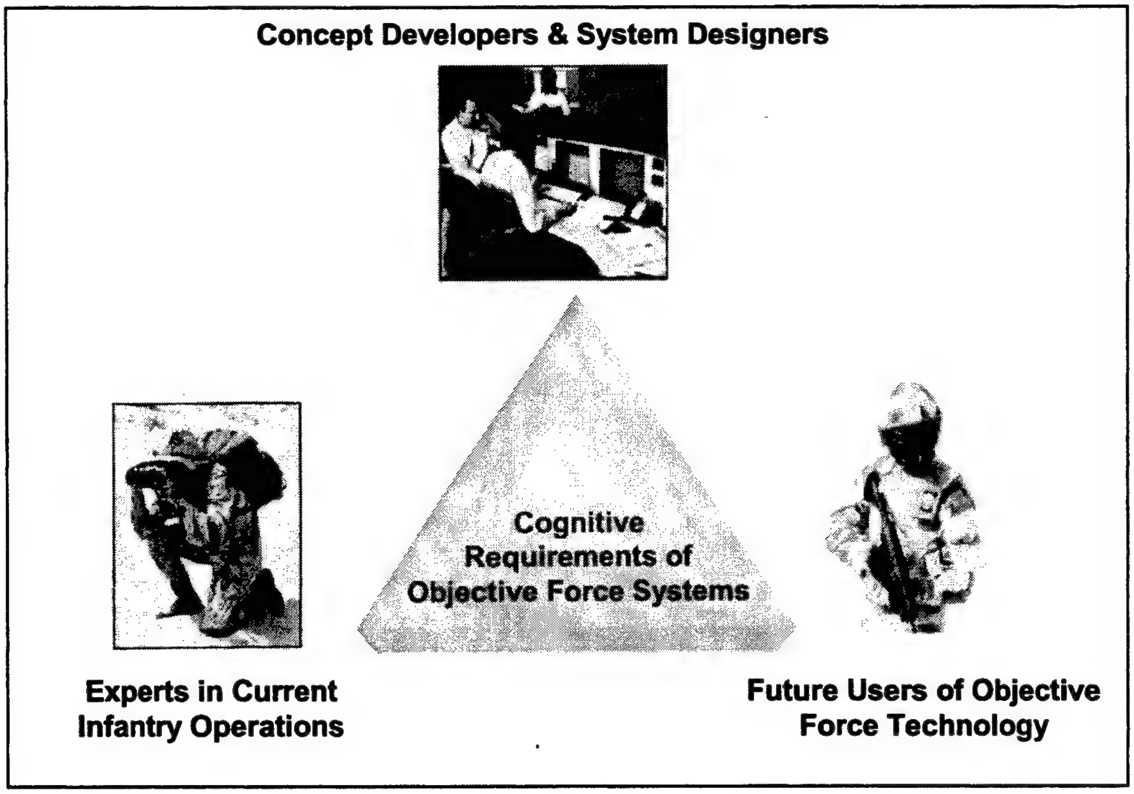

Figure 1. Three sets of interviews conducted to triangulate the cognitive requirements for the OFW system.

At the conclusion of this interview, we were able to classify OFW information into two types. The first type consisted of a more detailed version of current information – something that is not currently available such as an overlay of enemy locations. The second type of information could be thought of as enhanced perception. For example, leaders could hear what they normally could not (i.e., heartbeats inside a building) due to enhanced technology. Another example is a haptic alert that feels like a tap on the shoulder. With the enhanced perception information, integration or data fusion is not a barrier because the information was in a typical form, only enhanced. However, information integration or data fusion is an essential and challenging skill associated with digital information. We also found that many of the specific decisions about how information will be presented have not yet been made. This helped us avoid being sidetracked by the details of the knobs and dials and forced us to operate at the level of type of information presented and what is being conveyed.

An Infantry SME was acquired to provide the perspective of the current Infantry leader and a future user of OFW technology. The SME had over 6 years experience in Infantry including operations in Honduras, Nicaragua, Korea, and Desert Shield/Desert Storm. He was in the 82nd Airborne Division and had experience as a squad leader. We met with the SME twice. During the first interview, the discussion included background information, training, leader challenges, and urban operation strategies and cues. The goal of the interview was to obtain a baseline of decisions and tasks, how the decisions were made, how and what information was used, and associated challenges.

In preparation for the second interview, we created four urban scenarios to use as the basis for specific questions. The SME discussed how he would complete the mission with standard equipment – the strategies used, decisions made, communication practices, information available, and challenges. The SME then discussed how the mission would change with the addition of OFW information technologies. The interviewers described different specific technologies and the SME envisioned how this would change decision making and actions. The goal of this interview was to understand the cognitive requirements of the OFW technology.

Several key insights were gleaned from the SME interviews. One theme was that spatial orientation and data fusion were particularly challenging tasks in general. This problem was worse in terrain where it was difficult to see major landmarks such as in a thick forest or inside a building. Knowing where you are within a building is not a trivial task, especially when the floor plan is unfamiliar and there are few distinguishing interior or exterior landmarks. This is exacerbated when trying to communicate where you are in a building or trying to track which rooms have been cleared. A Soldier may mark an "X" on the hallway door of a cleared room but this does not help another Soldier who is approaching the same room from an interior adjacent room. This problem becomes even more complex in OFW when leaders will be expected to reconcile still images or video feeds from inside a building to their current perspective whether inside or outside the building.

Generate Techniques for Training Development

The third task was to generate techniques for a uniform training development process. We initially planned to document a generic methodology for specifying and training Infantry leaders to use the digital information in OFW. We envisioned this generic methodology could be used as the OFW information technologies become a reality. This plan was slightly altered. Instead of a methodology for specifying and training for digital information, we specified initial plans for a tool to train for many different types of digital information. The tool would be flexible enough to address information technologies that have not yet been envisioned. The emphasis would be on realistic practice using the types of information that will be available to the OFW leader. This practice with digital information would allow a leader to feel more comfortable dealing with it. Leaders could learn to use this digital information to fill in their situation awareness as they currently do with probabilistic cues.

The findings, discussed in the next section, were used to outline initial requirements for an interactive simulation for decision training. These requirements were based on the needs identified during the data collection. The OFW program needs a tool to train the ability to integrate and fuse digital information. The tool needs to provide repeated practice and feedback in these skills. While the needs of the trainee and the end application will be addressed, the primary focus of this task would be on the training developer who will use the tool to create practice scenarios. By making the tool easy to learn and use, training developers can incorporate a variety of information technologies and challenging situations. The scenarios can be tailored to meet a specific need or training requirement. This way the training scenarios are directly linked to training requirements. The tool also needs to be accessible from any location so it can be used in the field and so the largest number of trainees has access to a wide variety of training scenarios. A description of the tool, the Simulated Field Exercise Tool, is found in subsequent sections.

Develop Sample Training Scenario

The final task was to develop a sample training scenario. This was a paper-and-pencil version of a scenario that could eventually be converted to an electronic scenario when the interactive training software is built. The development of the sample scenario served two purposes. It provided the context for an interactive training tool. It also helped us further define and refine our understanding of the training tool. The context of the training scenario was developed by an Infantry SME with several iterations and significant input from the concept developers for the tool. The training scenario does not specify the exact information that would be in the electronic scenario, it simply specifies the information that would be used to develop an electronic scenario. The completed scenario can be found in Appendix A.

FINDINGS

This research effort worked toward the completion of the four primary objectives identified in the introduction and the development of plans for the Simulated Field Exercise Tool. The following sections describe and discuss these findings.

Objectives

Objective 1: Understand the Decision Requirements for the Dismounted Infantry Leader

For the most part, we found that the decisions a small unit Infantry leader needs to make to perform tasks on the battlefield are the same whether he is using conventional techniques or envisioned electronic information technologies. The tasks may be new such as policing looters in an occupied country or ones that are more familiar to our leaders such as clearing a building or moving tactically. If the decision maker is using conventional techniques, he relies on an intuitive understanding of the situation resulting from training and experience. If he has electronic sources of information about the situation he is entering, he needs to be much more analytical in his approach to decision making. In other words, the process that the decision maker uses to make the decision and the accuracy of the information used to make the decision are very different in the two environments even though the decision itself is the same. By this, we mean that, in both environments, the leader would need to make military decisions such as whether to enter a building or whether to call for fire. However, decisions in the digital environment will be based on more certain information than those in a conventional environment that are more inherently intuitive.

Objective 2: Compare and Contrast the Processes of Information Gathering and Decision Making for the Dismounted Infantry Leader in Conventional and Digital Environments

Small unit leaders using conventional techniques to assess the battlefield situation use their own perception and understanding of the environment to gain some level of situational awareness. Mosier (2001) refers to this level of perceiving the environment first hand as correspondence. *Correspondence competence* refers to an individual's ability to accurately perceive and respond to *multiple fallible indicators* in the environment (Brunswik, 1956).

Correspondence is a relatively "natural," adaptive process; "…we exercise our correspondence judgments almost instantaneously without thinking, just as we correctly perceive the world around us without thinking, without making strong, conscious demands on memory…" (Hammond, 2000, p. 35). When this kind of correspondence is used in decision making, Klein (1998) refers to it as *Recognition Primed Decision making* or *naturalistic* decision making, meaning that the decision is based on intuition derived from experience with and possibly training about the situation. An important issue regarding the correspondence definition is the statement that cues or environmental indicators can be fallible, meaning that the cues are only *indicators* and not ground truth. Therefore the decisions made using this approach are prone to some level of error both in interpretation (is it reasonable that x indicates y) and in the probability that the indicator matches ground truth (i.e., x usually indicates y but in this situation x is a distracter or caused by something else). For example, movement detected in a building suspected to be held by the enemy is a good indicator of enemy presence but it could also be something caught in the wind.

When a decision maker uses information from a number of sources that are not a result of perceiving the world first hand, he or she needs to maintain a logical consistency in the decisions made based on the different bits of information. For example, in the aviation domain, commercial pilots in modern automated cockpits have multiple sources of digital information that together describe a picture of the current situation. The digital information is generally portrayed as reliable and, as such, is qualitatively different from the probabilistic cues derived directly by the pilot from the environment. The pilot needs to ensure that digital information about system and flight parameters are consistent with each other for the given situation. Mosier (2001) refers to this as coherence. Coherence competence must be acquired artificially and usually requires training on what constitutes coherence. Gaining and maintaining coherence competence also requires time to think and to apply what has been learned. Coherence is more susceptible to time pressure, distraction, and stress than correspondence. However, when the digital systems are functioning correctly, the information itself is less fallible than correspondence.

The OFW leader will have access to numerous sources of digital information. However, he must be trained to maintain coherence in order to get an accurate picture of the battlefield or other mission environment. Even reading a map requires more analytical thought than perceiving the environment first hand. *The difference is not so much that it is digital or that it is certain, the main difference is that it requires an additional step of data analysis and fusion because information is not from the leader's own perception.* Sensors that provide graphic images or even live video can give the leader much more information than he currently gets in the conventional battlefield environment. This information is not from his personal perception but from the perception of the sensor. Spatial orientation will become a key issue and skill in the electronic battlefield. The OFW leader will need to understand the data being sent to him from the sensor's point of view and then translate that into information that he can use to make a correct decision. For example, he will not only need to know where a sensor or robot is in relation to his own position, but he will also need to know which way it is pointing and how long it has been since the image was sent. This is quite different from personally looking down a street or peering around a corner for signs of an enemy.

A familiar example is being in a large shopping mall with a plan view map display of the locations of each store in the mall and an icon with the indication that "you are here." Even using this relatively simple map, it still takes time to become oriented. You usually have to look around at the stores nearby and then try to find them on the map to gain your perspective. If an OFW leader, conducting a building clearing operation in an urban environment, is told the location of enemy forces by a "perch and stare" uninhabited aerial vehicle (UAV) sensor and the leader is even slightly disoriented as to where the sensor is looking with relation to himself, the results could be disastrous. Making decisions from wrongly perceived information may be worse than making decisions from no information at all.

The OFW leader will use both correspondence and coherence, or his own perception as well as information provided to him about the relevant situation, to make decisions, just as a pilot shifts between looking at the world through the cockpit window and through digital displays inside the cockpit. Training to help the OFW leader take advantage of the new information provided to him, rather than being confused or misled by it, will be crucial for the leader.

Objective 3: Link Decision Processes in a Digital Environment to Training Strategies for the Dismounted Infantry Leader

To make decisions in an electronic battlefield most effectively, the small unit leader will need to take advantage of the information that is available. Currently, the majority of a dismounted Infantryman's training after Advanced Individual Training at the U.S. Army Infantry School is done at the unit level through realistic field exercises which are followed by after action reviews (AARs) where the leaders get critiqued by either the unit commander for less formal exercises or by designated observers for larger exercises. These field training exercises may be repeated numerous times before the entire unit is able to demonstrate mastery of the skills needed to perform the exercise.

Recent Army research supports the concept of constructivism, or using experiences in a real world context for digital skills training. This real-world approach to training facilitates a deeper understanding and better transfer of training (Schaab & Moses, 2001). However, realistic field exercises, while they may be effective, are not efficient enough to provide all of the training a dismounted leader needs. The data fusion requirements for making decisions on an electronic battlefield can be addressed by a computer-based tool that replicates the field training exercise strategy. The critical skill addressed is digital data fusion and sense making in the context of a mission. By simulating the planning that occurs after receiving an operations order (OPORD), the execution of those plans, and the feedback to leaders that occurs during AARs, the tool could provide unlimited realistic experiences that can be embedded in the leaders' planned personal computing equipment. The advantage over existing training scenarios is the addition and emphasis on integrating electronic sensor information as cues.

Computer-based field exercise scenarios that require a leader to fuse data correctly from a variety of information sources can be practiced and critiqued, permitting the leader to learn experientially to make decisions in the electronic battlefield. The exercises can be developed by experienced Army Infantry training developers or by unit commanders, hosted on a network, and downloaded at appropriate times by OFW leaders. This strategy would not remove the need to conduct live field training exercises and AARs but it could cover a wider variety of combat

decision-making skills and lessen the need to repeat live field exercises. It would be an inexpensive and feasible training and practice opportunity.

Objective 4: Define and Document a Computer-Based Training Methodology for Envisioned OFW Systems

When this objective was initially specified, we envisioned developing a methodology for learning how planned OFW digital information technologies would be used and how data that could be pulled from different sources could be fused to allow the small unit leader to make the best possible decisions at mission planning time. Then we planned to link the cognitive requirements to training requirements for a computer-based training tool.

As we started working on satisfying this objective, our focus changed slightly. Rather than just coming up with a process for understanding new tools via some methodology like a Cognitive Task Analysis, we realized that the technology that could most benefit the Army would be a methodology that is embedded into an interactive tool for authoring simulated field exercises. This tool could be hosted on a network, downloaded by dismounted Infantry leaders, and embedded in OFW personal computing equipment. Therefore, it is the scenario authoring tool that is generic – it can be used to address a wide array of decisions, missions, and most importantly new digital information as it evolves.

This authoring tool would need to be robust enough to include information from all of the currently planned technologies and have the capability of adding new information technologies as they are conceived and developed. The authoring tool would also need to be capable of presenting simulated field exercises for virtually any OPORD.

Infantry training developers and unit commanders would be the target audience to develop the OPORDs and create the simulated field exercises. They would be able to control the number of courses of action that a small unit leader could choose in planning for execution of an OPORD and provide instructional feedback for the choices that are made. Feedback could also be provided on how information should be pulled from various information sources and fused to come up with the best decisions for the given situations.

This effort focused on understanding the novel training requirements for the OFW leader. Some of these requirements turned on practical concerns while others turned on theoretical considerations. In short, we recognized that despite the increasingly analytic nature of the information fusion skills that will be required of the OFW leader, a "naturalistic," or experiential training regimen would be an effective way to hone these skills. Moreover, we realized that it must be possible to develop and conduct this training independent of the emerging digital technologies that will ultimately support the information fusion. The tool we describe below embodies the realization of these requirements.

The tool could be used to develop and deliver training that permits Infantry small unit leaders to practice the integration and sense making of digital information that will characterize the OFW environment. The information fusion would be in the context of scenarios in which the small unit leader must use the information effectively to make decisions. Therefore, the tool would not simply teach information fusion, it would teach information fusion in action.

Requirements of the Simulated Field Exercise Tool

An Authoring Module for Training Developers

This authoring module of the tool would allow training developers to design training scenarios that include scripted activities for civilians and elements of the threat force. The training scenarios encourage the trainee to integrate disparate digital information effectively. The authoring module would allow the training developer to specify the situation, the decision points, the sensor information available, and the decision alternatives. The authoring module would need to be flexible enough to incorporate novel information sources and be specific enough to help the training developer present a consistent (if sometimes intentionally confusing) picture to the trainee.

A Sample Training Module for OFW Leaders

A training development and delivery tool would require a sample training module to illustrate its use. The sample training module would consist of several training scenarios. It could serve as both a proof-of-concept and case study example for training developers. Realistic pencil-and-paper scenarios such as that given in Appendix A could be translated to electronic scenarios using the authoring module of the tool. The training scenarios would be the beginning of a library of practice scenarios linked to training objectives. The training scenarios would cover the spectrum of war (i.e., small scale operations, stability and support operations, operations other than war) and a variety of terrain (forest, desert, urban), while incorporating multiple information technologies (e.g., heartbeat detectors and glint detection).

A Training Module to Teach Training Developers How to Use the Tool

It is essential that the tool be maintained by the Army as opposed to a contractor. Army training developers would ultimately be responsible for creating training scenarios or modifying scenarios to incorporate new information technologies. To support Army training developers the tool must contain a training module to teach training developers how to use the tool and how to develop effective scenarios. The training module could walk training developers through the scenario development process and provide tips and strategies for effective and engaging scenarios.

Software That Stores Training Scenarios and Makes Them Accessible via a Network (e.g., the World Wide Web)

The tool could also contain a library of training scenarios available for download. This would allow the end user of the tool, the trainee, to access training scenarios from a variety of remote locations. It also would allow for easy dissemination of scenarios to a wide audience. This is important because these types of training scenarios are most useful for leaders to use in preparation for deployment or during downtime while they are deployed. Another advantage would be the possibility of an online discussion forum to engage a community of "tool" users.

Functional Description of the Simulated Field Exercise Tool

The training tool would comprise three main applications: (a) a computer-based authoring application for developing training modules, (b) an embeddable run-time application for executing the modules and (c) a web-based application for distributing the run-time application and for uploading, storing and downloading individual training modules. The functional description of each of these applications is described below.

Authoring Application

The training tool would train information fusion skills at a high level of abstraction. Rather than focus on the details of operating new technologies, the training developer would author modules that train the coherence competence necessary to use the information made available by those technologies. Each module would consist of a simulated field exercise in which the leader is presented a variety of information sources and a series of decisions that require him to pull the appropriate information, from all the information potentially available, and make sense of it. The leader would interact with a Plan View Display (PVD) of a region (displayed either on a computer or embedded in one of the displays organic to the OFW digital ensemble) by querying information assets located on the PVD. The course of action chosen at each decision point would determine the subsequent events, decision points, and information available to the leader. The critical transfer of training is to teach the leader how to make sense of that information to make good decisions. To ensure this transfer, the training developers must do three things: (a) they must define a context for the simulated field exercise; (b) they must determine what information is available to make decisions and to provide meaningful feedback, and (c) they must define decisions points in such a way that making good decisions does, in fact, depend on fusing the right kind of information in the right way.

Establishing Context

Each training module would be built around a scenario. The scenario in turn would provide the context in which the simulated field exercise occurs. This context would be defined in two parts. First, the training developer would provide a narrative description of the situation (please see Figure 2). In this way, the training developer can establish the type of exercise that would be simulated (e.g., war, stability and support, operations other than war), the mission phase (e.g., mission planning vs. execution), and the cognitive challenges (e.g., determining how to approach a building, dealing with inconsistent information, etc.). The training developer would also supply some of the background knowledge that might bear on information fusion (e.g., reports of sniper activity might suggest glint-detection as an important source of information). The narrative description could also be written and presented as an OPORD, thus adding both realism to the simulation and structure to the series of decisions the trainee must make (e.g., questions about how the trainee plans to move from waypoint to waypoint in urban terrain). Additional background information might include rules of engagement (ROE), the events that have led to the current situation, or even the immediate events that lead the leader to the first simulated decision point.

After completing the narrative description of the situation, the training developer would define the physical environment in which the scenario occurs. The training developer can choose from canned topographies (e.g., littoral, jungle, mountain etc.) or construct his own using a built-in Terrain Editor (please see Figure 3).

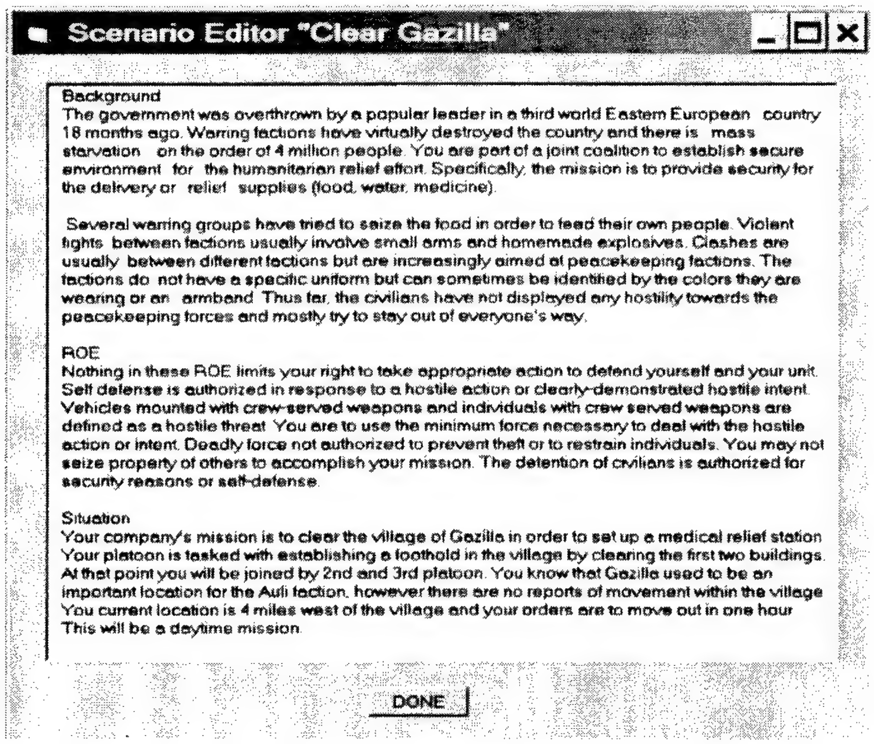

Figure 2. The Scenario Editor. This interface would accept text-based input. The training developer would use this interface to supply background information to the leader, presenting either a narrative description of the situation or an OPORD.

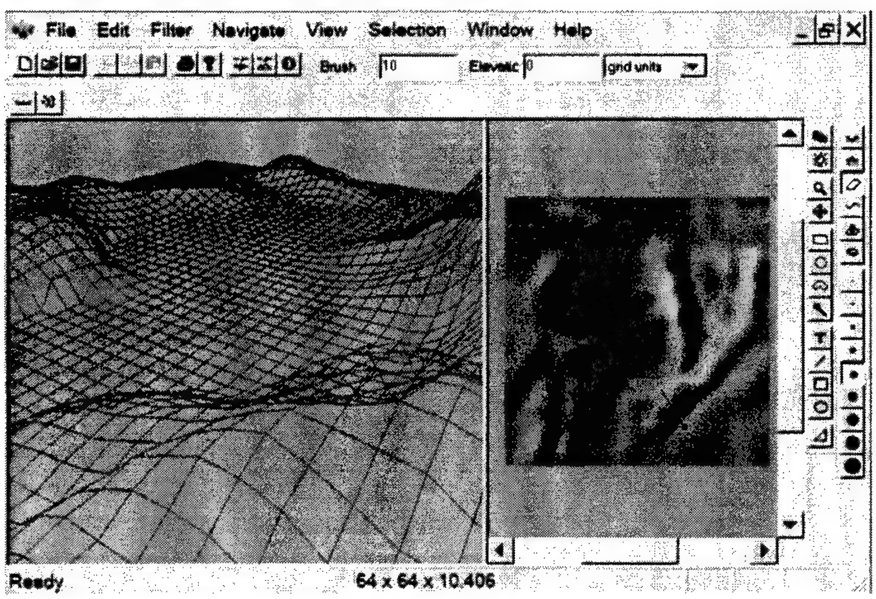

Figure 3. Terrain Editor. A commercial of-the-shelf example is used to demonstrate the look-and-feel of a Terrain Editor. The training developer will use such an editor to create geography for the scenario. In addition to providing the landscape, this editor will also allow the training developer to present fully rendered images of the environment from select perspectives, as if those images were being provided by video sensors.

Defining the Available Information Elements

The scenario and the physical environment are both constant features in the training module. They are background elements. Having specified them, the training developer is able to define the foreground elements, namely, the sensors and information streams available to the trainee. The training developer does this by first placing objects on the PVD for the sensors to detect (e.g., buildings, vehicles, leaders, civilians), and then he decides what information assets will be available to the trainee (e.g., UAVs, unmanned acoustic sensors, physiological data from leaders, etc). Finally, the training developer specifies what information each asset will present and how it will be presented (e.g., as map overlays, video imagery or text-based messaging). This would be accomplished using a PVD Editor (please see Figure 4).

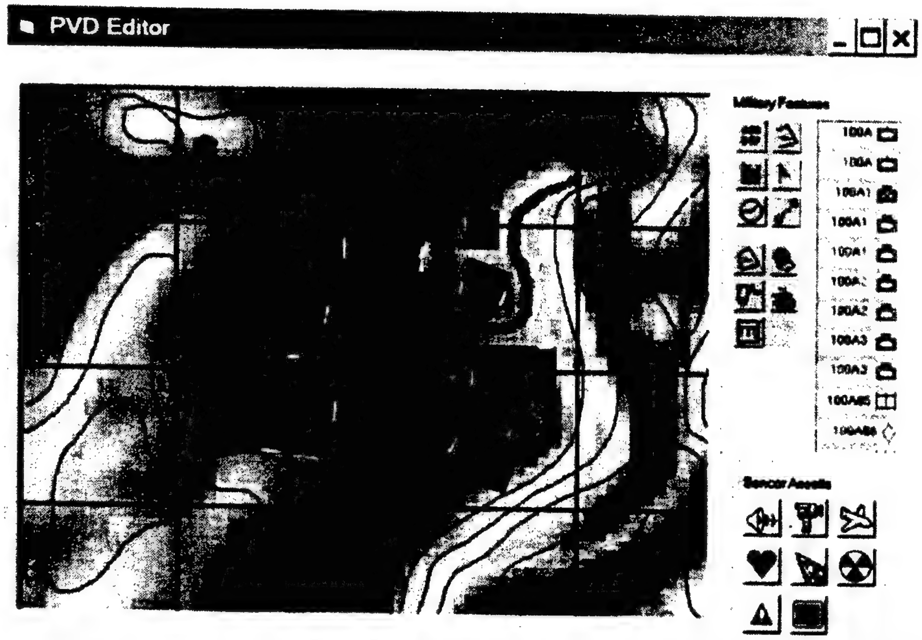

Figure 4. PVD Editor. Having created (or chosen) geography for the scenario, the training developer uses this interface to place both objects and information sources on the PVD. The developer uses this editor to control what the leader will see at each decision point in the scenario.

Each information asset placed on the PVD would be treated as an object with its own properties. These properties define the asset in terms of the information it presents to the leader (see Figure 5). In this way, the training developer can control what the trainee "sees" as opposed to what "actually" exists. The senses of "see" and "actual" here are somewhat metaphorical; the intent is not to hone the visual acuity of the OFW leader, nor for the training developer to labor over a detailed model of a real-world battlefield and the physics of a given sensor to determine what can and cannot be detected. Rather, it is up to the training developer to construct "ground truth" for the scenario and then to decide what slice of that truth a sensor will present. As indicated above, the tool would provide the training developer an instrument for training the high-level information fusion necessary to make tactical decisions. For example, the training developer might envision a situation where effective decision making depends on the detection of a well-camouflaged tank. Moreover, the training developer can dictate that the tank will not be

visible in the low-resolution video feed available to the leader. Thus, if the leader is to "detect" the tank, he will be forced to rely on alternate information sources, perhaps an infrared image, or reports from acoustic sensors if he is to make an effective decision. (See Figure 8 for an example of what the leader would see when interacting with his PVD.) Similarly, the training developer might imagine situations where visual orientation is crucial to a decision. In such a case, the training developer can specify the orientation of video sensors and thereby determine the first-person perspective of the images those sensors provide (the underlying software would render those images given the developer's input to the PVD Editor). Finally, the training developer can set the properties for an asset such that an information source fails to display data or displays inaccurate data. By coordinating the properties of both sensors and the objects they detect, the training developer would be able to present a digital view to the leader in which the achievement of coherence competence depends on reconciling disparate data sources, diagnosing inconsistencies across the data or even dealing with missing or erroneous data.

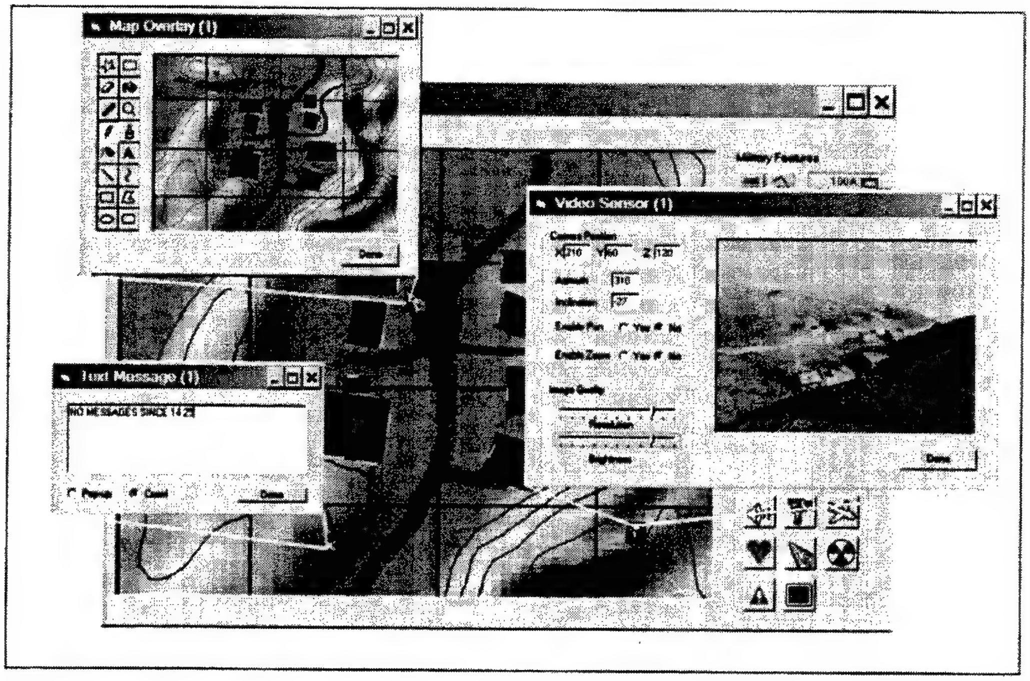

Figure 5. Sensor Property Windows. This figure depicts the property windows for three different modes of information presentation. After an information source has been placed on the PVD, the training developer can specify how that information will be presented to the leader should he query the source. The window on the top left shows how map-overlay information might be specified. In this case, the developer has provided the leader with information about enemy fields of fire. Using a simple drawing application, the training developer can decide how that information will be overlaid on the leader's PVD. The window on the bottom left shows how a text messaging will appear to the leader. Here the training developer has selected the "crawl" option, which will cause the input text to crawl repeatedly across the leader's PVD. Alternatively, the training developer could have selected the "Pop-up" option in which case the text would appear only if the leader chose to query the appropriate information source. Finally, the window on the right shows how a "video" image will appear to the leader. This image will be rendered as if the camera was, in fact, perched at the location indicated on the PVD.

While the construction of the scenario and the physical environment is limited only by the imagination of the training developer, the information assets and their properties are constrained by the available technology (or, in the case of the OFW program, the proposed technology). For this reason, the tool would not contain a monolithic catalog of assets, nor would it contain detailed lists of the properties that reflect the actual capabilities of the proposed OFW technologies. Instead, the information assets and their properties would be considered at a notional level, where information and its mode of presentation are specified in generic terms. Thus, the focus would be on the information that can be presented in terms of map overlays, text messages (which would serve as a reasonable surrogate for radio messages), and video images. However, depending on the capabilities of the leader's personal computing equipment, the tool might contain other outputs such as a text to speech converter. Although this might seem limiting, interviews with the OFW development team suggest that much of the information will be presented exactly in these ways. (Many of the remaining technologies focus on enhancing perception and improving correspondence competence.) Still, as new information technologies and modes of presentation are likely to emerge (e.g., haptic warnings), the training developer will have an option to edit the catalog of information assets, adding and deleting assets as necessary. The authoring module will be flexible and allow the training developer to display information from a sensor that has not yet been developed.

Defining Decision Points

The last step in constructing the training module is to define the decision points. These decision points drive the interaction between the leader and the scenario while requiring the leader to fuse information. The training developer will use the Decision Point Editor to define decision points (please see Figure 6).

As its name implies, a decision point represents a discrete event in the scenario where the leader is forced to choose a single action from a small, pre-defined list of alternatives. This decision must be made with the information available at that point in the simulated exercise. Each decision, in turn, can affect the information that will be available at later decision points. Finally, each decision the leader makes is subject to evaluation. The training developer represents these aspects of the decision point as follows. The training developer begins by entering text in the "Prompt" frame that will prompt the leader's decision. This prompt might include additional background information or novel situational developments. The training developer then describes the decision required of the leader. The description could include a narrative discussion of the available alternatives, but the alternatives themselves will be listed separately when presented to the trainee (please see Figure 9 below). Next, moving item by item through the combo box within the "Action" frame, the training developer specifies the consequences of each alternative.

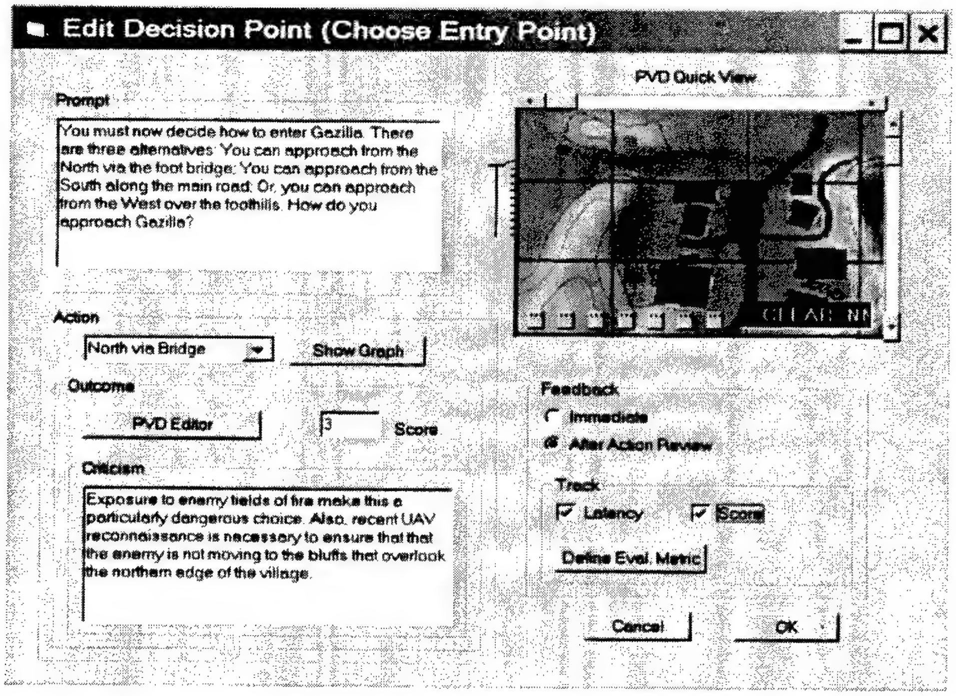

Figure 6. Decision Point Editor. This display allows the training developer to specify the decision, alternatives, and consequences.

Consequences are twofold. First, each decision can impact the state of the digital world at the next decision point. The training developer reflects these impacts by calling up a fresh PVD Editor and setting sensor properties as needed for the downstream decision points (including, perhaps, adding new objects and sensors to detect them). By default, the digital world, as initially specified with the PVD Editor, will remain unchanged. Second, each decision impacts the feedback and evaluation the leader receives. Ideally, the training developer will structure the decision points so that choosing the best alternative depends on querying particular sensor assets and drawing appropriate inferences. For instance, in deciding how to approach Gazilla (recall Figure 6), the choice of approaching from the North should be ruled out if the leader fuses the information from his overlay of the enemy fields of fire from his PVD. Likewise, the leader should pull the most recent UAV feed to ensure that the enemy has not moved to occupy high positions at the Northern end of town. Should the leader happen to choose that alternative, the training developer can provide critical feedback as well as increasing or decreasing a running score that can be used to measure the leader's performance (the tool will contain additional software to support the development of scoring routines and evaluation metrics). Finally, the training developer can verify the information available to the leader by inspecting the "PVD Quick View" and he can decide how feedback will be tracked and administered (immediate vs. AAR.

A series of decision points would represent the flow of events through a scenario. On the one hand, this flow needs to be sufficiently dynamic to capture the leader's interest and the richness of the tactical situation. A rigidly scripted sequence of events is unlikely to provide much transfer of training. On the other hand, however, making the flow of events genuinely dynamic would require an underlying simulation engine, complete with physical models of the

sensors, intelligent models of the opposing forces and an interface to allow the leader to "move" however he chooses through the scenario. This has some disadvantages. It greatly increases the complexity of development for the tool and, more importantly, it results in a loss of instructional control. The tool will split the difference here. At each decision point, the leader will be able to choose from a list of alternatives. Each of these alternatives, in turn, can lead to new decision points. What the leader sees at each point in the scenario would depend on the choices he made earlier. However, in order to avoid the computational overhead entailed by a genuinely dynamic scenario, it is up to the training developer to ensure that events unfold consistently; that is, the training developer would play the role of an underlying simulation engine. To help the training developer visualize the various "paths" through a scenario and to maintain consistency along each path, the tool will contain a "Decision Organizer." This interface will support the graphical representation of the scenario where nodes represent decision points and edges represent alternative courses of action available (please see Figure 7).

This interface will provide a simple point-and-click environment in which the training developer can define more or less complicated scenarios. The software underlying the interface would also ensure that the topology of the graph is preserved; the training developer would be required to specify a decision point for each node and the alternatives available at each decision point will be dictated by the directed edges emanating from the corresponding node. The training developer would be able to access the associated Decision Point Editor by double clicking the corresponding node on the graph.

Run-Time Application

The Authoring Application that supports the development of training modules is complex. It must accept text-based input for the training developer to define a training scenario (either by way of an narrative description or an OPORD). It must allow the training developer to: (a) construct (or select) a synthetic environment; (b) place both objects and information assets in that environment and then specify how each asset will present information about those objects (including the rendering of 3-D images from selected points in the synthetic environment); (c) define individual decision points within that scenario in terms of a prompt to the leader, a list of alternative actions and an enumeration of the consequences of each possible action (including changes of state for the next decision point and feedback to the leader); and (d) define potentially complex trees of decision points. Finally, the authoring application must "compile" the user input into a training module that can be edited, saved, uploaded and then downloaded to be run on either another computer or as an embedded training application (perhaps running on a personal digital assistant, PDA).

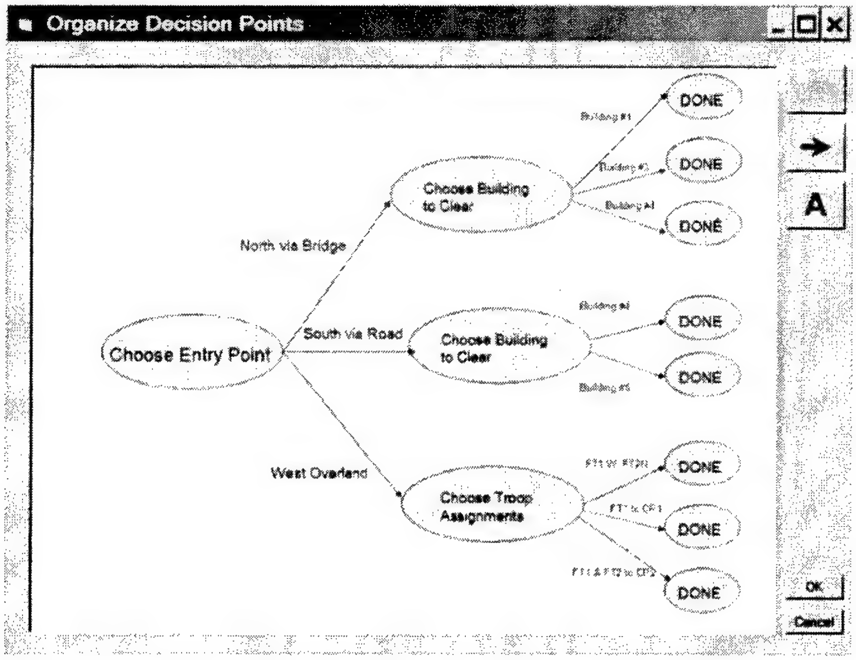

Figure 7. Decision Point Organizer. This interface allows the training developer to define complex scenarios by linking together decision points. Each node in the graph represents a decision point.

By comparison, the Run-Time Application is simple. Given a "compiled" training module, the Run-Time Application need only support the interaction between the leader and the scenario and collect whatever performance data the training developer specified (either response or latency at each decision point). The interaction between leader and scenario begins with the display of the text-based background information. This information can be displayed to the leader in very much the same way it was entered in the Scenario Editor (recall Figure 2 above). Next, the leader will see the PVD. Depending on what the training developer specified by way of the PVD Editor, the leader will be able to query various information sources, with the displayed view changing accordingly (please see Figure 8).

At this point, the leader can select whatever information source he chooses and review it, changing between plan-view displays, text messages, video-feeds, even zooming and panning through images assuming the training developer made such modes of information presentation available. However, the real interaction begins when the leader is forced to do something with the information that has been made available to him. This interaction is forced by the appearance of a dialogue box that is either event-driven (e.g., when the leader queries a particular information source) or time based (e.g., 1 minute after the leader closes the window that contains the background information). The dialogue box represents a particular decision point and contains both the prompt and alternatives specified in the Decision Point Editor by the training developer (please see Figure 9).

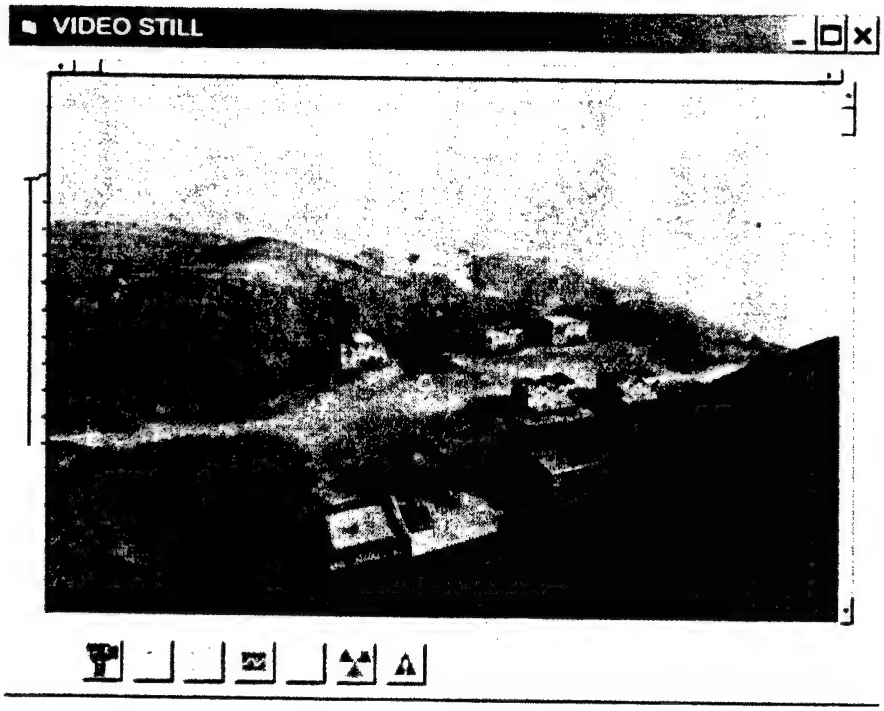

Figure 8. This figure depicts what the leader will see after selecting the video information source from his PVD (cf. Figure 5).

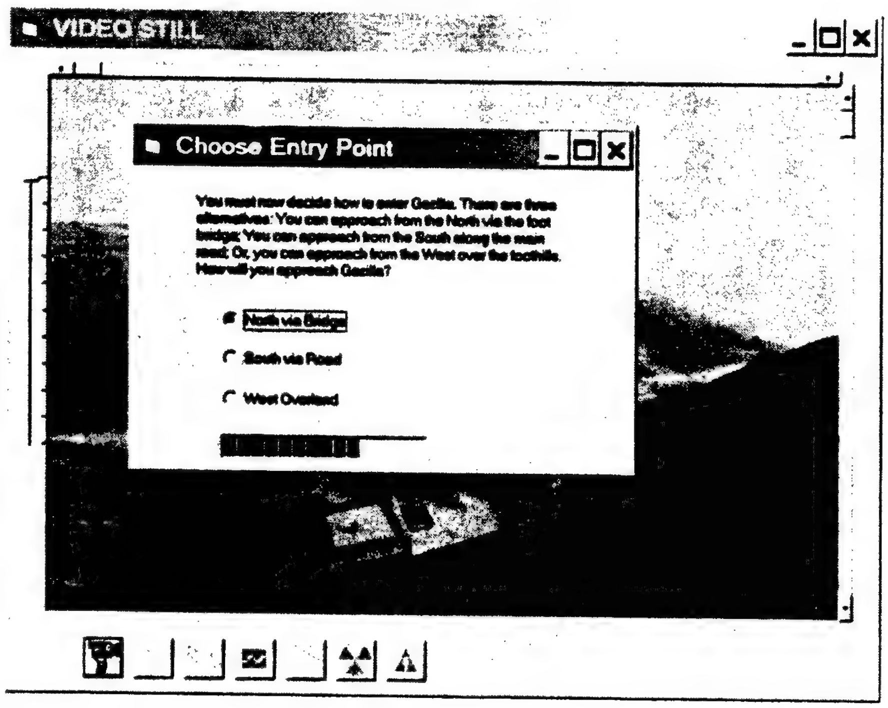

Figure 9. This picture depicts a decision point at run time. The prompt and alternatives have both been automatically extracted from the training developer's input to the Decision Point Editor (recall Figure 6). Although the dialog requires user input in order to advance to the next decision point (i.e., the tool does not "time out" the decision), a progress bar is included to impress the need for a timely decision.

This dialogue box would be modal, requiring the leader to respond before the exercise can continue. Once the leader responds, the response will be recorded and, depending on the training developer's original specifications, feedback will appear immediately, or it will be stored for an "after-action review." In either case, the leader's response will dictate the subsequent state of the training scenario and the next decision point to be reached.

Development of training modules will be organized into exercise "sets" or "groups." An exercise group could consist of a single simulated field exercise or it could contain many exercises that are related in some way by the training developer. The developer would also be able to recommend or dictate the sequence of exercises within and between exercise groups. When developing exercises, the developer will be able to select an option that lets him or her specify a prerequisite exercise. When a leader completes an exercise, a flag would be set to indicate that the exercise has been completed. Exercises that have prerequisites defined by the developer would not be available to the leaders until the prerequisite exercise has been completed successfully.

As mentioned earlier, exercises would also be scored. The developer's recommendation for the next exercise or group of exercises can be based on the leader's score on the current exercise. Clever and creative training developers would be able to build complex training experiences for the leaders with remedial exercises and different sequences based on a leader's performance.

Of course, the exercises can be completely unstructured, allowing the leaders to select any exercise they want. The unstructured approach could also allow the unit commander to select or even develop the exercises for his subordinate leaders. The point regarding the organization of modules is that the tool will be extremely flexible to allow for many styles of training to emerge.

Embedding the Run-Time Application and Supporting Network-Based Distribution

Although the operating system that will ultimately drive the digital technologies envisioned for OFW is not specified, it would be a straightforward matter to distribute and execute the run-time application on Windows-based platforms (and there is some indication that the early development blocks will exploit existing Windows technologies). It remains to be seen whether any Windows-based handheld (or wrist-mount, or helmet-mount) devices actually make it in to the OFW digital ensemble, but even if they do not, the requirements for the run-time application are nominal. Whatever the platform that underlies the digital technologies envisioned for the OFW leader, if it supports the ability to read-in, save and read-out files, display images, and supports point-and-click (or tab-and-enter) input from the leader, a run-time application can be tailored for that platform. In this way, the run-time application can be "embedded" in the digital systems organic to the OFW leader. The term "embedded" is used loosely here, insofar as the run-time application will execute as a self-contained module within one of the OFW displays; the leader will not be using the actual sensor interfaces to pull information.

Once the run-time application is in place, the leaders will need access to the training modules. This access could be achieved in the field any number of ways (depending on the final specification of the OFW technologies). Lacking a network connection (or given a connection of limited bandwidth), modules could be distributed on portable media such as flash memory, floppy disks, or compact disks. Alternatively, leaders might have a transient network connection

that allows them to download modules and run them later. Once a leader has completed the training, he could reconnect to the network to upload his results. If users have a continuous network connection (or when bandwidth is not limited), they could get modules and use them at any time. In general, the network demands for the training tool will be minimal (bandwidth will be a precious commodity for the OFW system). A network connection would be needed only to distribute training modules and upload results and both these files would be small; there would be no need for a network connection at run time, when the application would run on a local device. A network connection would still be useful, however, insofar as it facilitates training in the field.

To support training in more traditional settings, a website could be built to support training developers, instructors, and leaders. The site could be based on one of many available learning management systems available based on the AICC (Aviation Industry CBT Committee) or SCORM (Sharable Courseware Object Reference Model) standards. Developers would be able to download the development tools and upload completed training modules. Leaders would be able to download modules, up-load their results and receive feedback from both instructors or other leaders participating in a moderated training on-line "forum" that could be set up and administered via the website.

CONCLUSIONS

The objectives of the research were successfully accomplished. The decision requirements of small unit leaders in both conventional and digital environments were investigated along with differences between them. Particular emphasis was given to the information fusion that precedes decision making. It was determined that although the decisions themselves will remain the same, the process and information used to make the decision will change. If the leader has electronic information about the situation he is entering, he needs to be much more analytical in his approach to decision making. Coherence will be an important skill in obtaining an accurate picture of the battlefield or other mission environment. Even reading a map requires more analytical thought than perceiving the environment first hand. *The difference is not so much that it is digital or that it is certain, the difference is that it requires an additional step of data analysis and fusion because information is not from the leader's own perception.* Spatial orientation is another key issue and skill in the electronic battlefield. The OFW leader will need to understand the data being sent to him from the sensor's point of view and then translate that into information that he can use to make a correct decision. Training will be crucial to help the OFW leader take advantage of the new information provided to him rather than being confused or misled by it.

These initial findings about decision processes in the electronic battlefield were used to develop training requirements and a replicable methodology for addressing different types of information. The tool needs to help leaders gain competence in data fusion and spatial orientation. Ideally, this training will be modeled after field training exercises and feedback elicited during AARs. The tool should present different decision options to the trainee dependent on his successful interpretation of disparate sensor data. The tool should be authorable and easy to use so that training developers and unit commanders can quickly develop training scenarios.

There should be a library of scenarios and feedback available to the OFW community. A computer-based tool that meets these requirements will ease the leaders' adjustment to digital information and help them become more competent at using and interpreting the information appropriately. By simulating the planning that occurs after receiving an OPORD and the execution of those plans, and by providing the leaders with feedback that occurs during AARs, the tool could provide unlimited realistic experiences that can be embedded in the leaders' planned personal computing equipment. The advantage over existing training scenarios is the addition and emphasis on integrating electronic sensor information as cues.

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APPENDIX A

Sample Pencil-and-Paper Version of a Training Scenario

Scenario Title: Attack on Objective Raven

Q 1

Question:
State Platoon Mission: Get from operations order (OPORD)

Answer:
1st Platoon A Company 2-66 will airland on HLZ Hawk and move on order to conduct an assault (DTG) on OBJ Raven vicinity 8900 4100 in conjunction with 3rd Platoon A Company 2-66, to capture key CLF leadership on-site, destroy the CLF command and control facility, destroy all remaining CLF forces, and collect intelligence information to disrupt and degrade the CLF leadership's capability to command and control its forces.

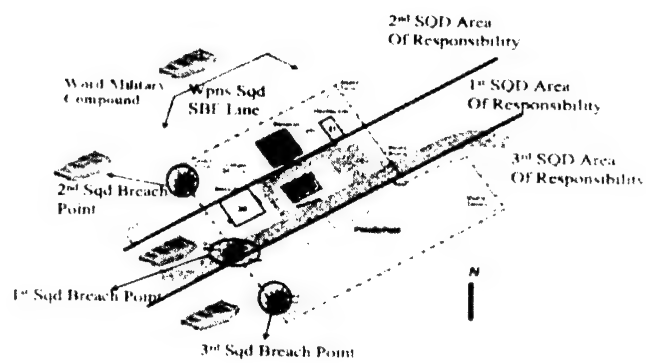
Q 1-1

Question:
What is your plan of attack on OBJ Raven?

Answer:
Once the Company gets the release code from HLZ Hawk, I will release a class I uninhabited aerial vehicle (UAV) to conduct my leader's reconnaissance of the objective. Providing any new intelligence I will have the support by fire line dismount and move to the North West side of the objective. A UAV will be on station to provide intelligence for the weapons squad. Once they are set, all UAVs will move into positions around each of the buildings and provide intelligence on the enemy. The Mules will be deployed one in the north and one on the south to seed the entire area with UGS. Once this is complete I would then have 2nd Squad assault from the North West corner of the OBJ by the guard tower, 1st squad would assault through the main gate breaching it with their ICVs, and 3rd Squad would breach the fence at the south west guard tower once I give the command. All breaches will be conducted with the ICVs. Following the ICVs will be the SUGVs who will take up their preplanned routes. 2nd Squad will secure buildings 33 and 31 while 1st Squad secures buildings 30 and 32. 3rd Squad will clear the southern portion of the objective and provide covering support to the other squads.

Supporting Graphic:

Objective Raven



Q 2

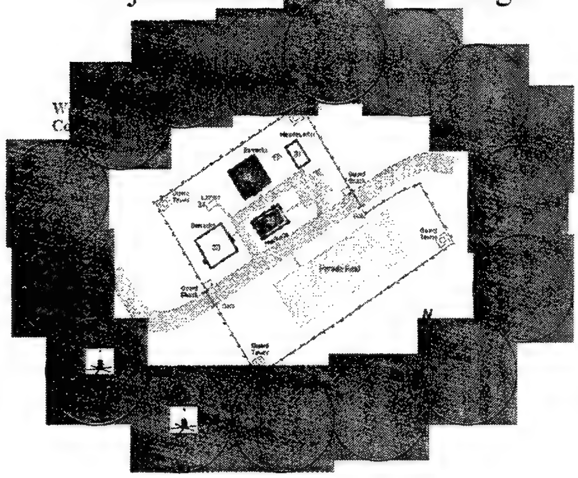
Question:

Where are sensors needed for the mission? Draw a sensor overlay.

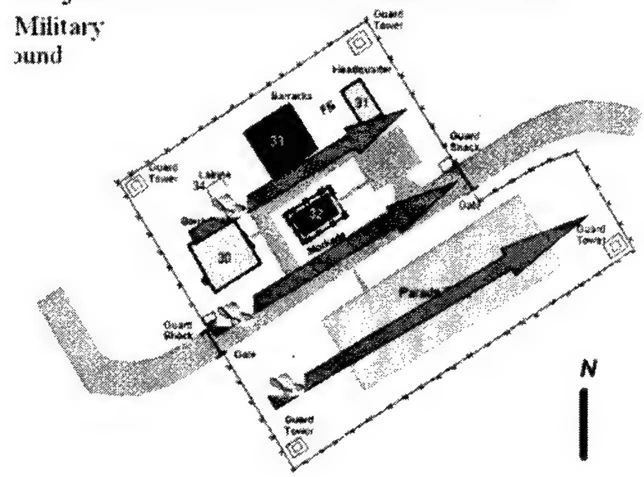
Answer:

See supporting graphics

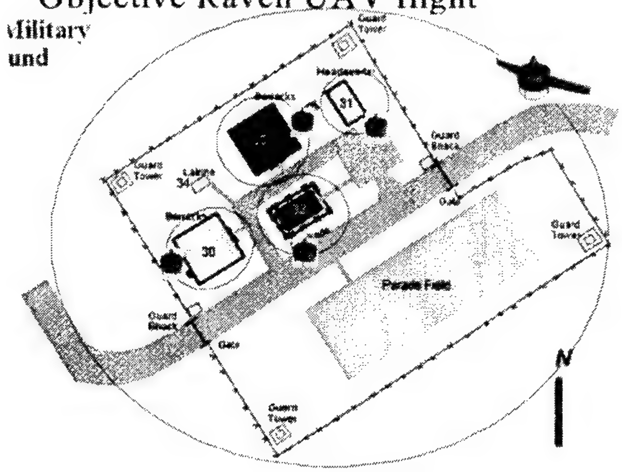
Objective Raven UGS Coverage



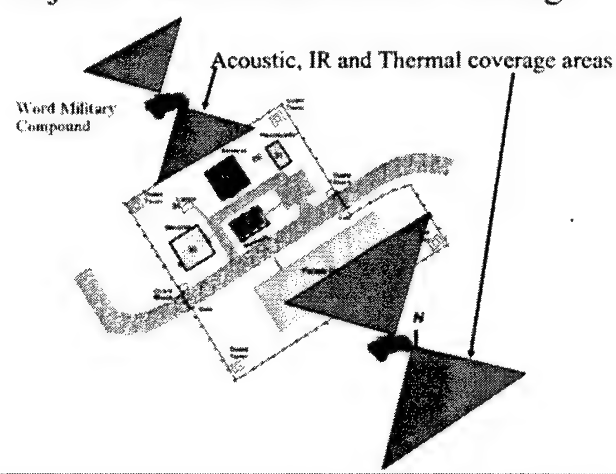
Objective Raven SUGV Patrol Routes



Objective Raven UAV flight



Objective Raven Mule sensor coverage



Q 3

Question:

You are conducting you leader's reconnaissance and finalizing the plan, how do you want to change your initial plan?

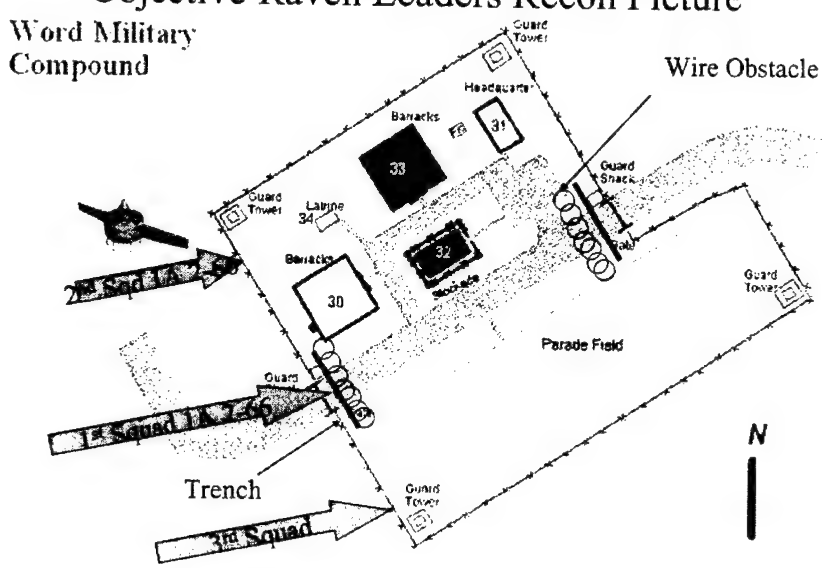
Sensor Information:
Picture of UAV flying over OBJ and taking pictures: shows trenches on west side of OBJ with barricades and the same on the east side.

Alternatives:
1. Do not alter initial plan.
2. Change assault direction to assault from the north and set up support by fire line (SBFL) to the west
3. Assault from the south.

Feedback:
In response to Answer 1. This is not a tactically sound response. Since your initial attack was originally planned from the west, and intelligence pointed out barricades blocking your breach points, you should have realized that the north or south avenues offered less resistance to your assault. Therefore, #2 would be the best answer in this scenario.
In response to Answer 2. Your analysis of the situation is correct. Since the barricades are blocking your initial avenues of approach and there are other paths that offer less resistance to your breaching teams, this solution offers the best alternative to your initial plan.
In response to Answer 3. Incorrect. While the intelligence has shown you that your initial approach is blocked, just moving the assault element without changing your support by fire line will more than likely result in catastrophic results (the SBF line would be directly across from the assault element resulting in fratricide).

Supporting Graphic:

Objective Raven Leaders Recon Picture



Q 3-1

Question:
From where would you approach the objective?

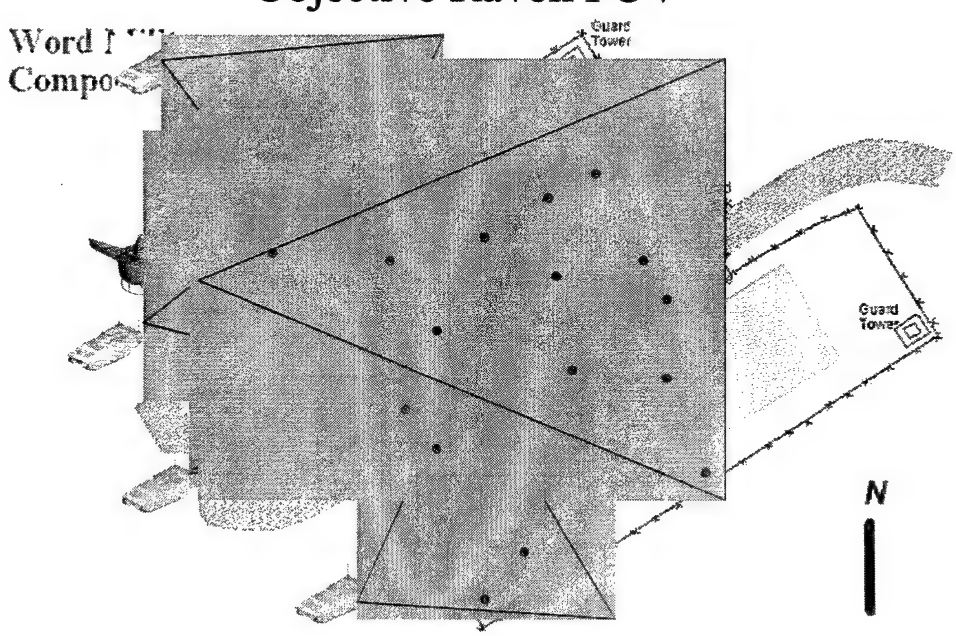
Sensor Information:
3d map with details of OBJ. ICVs view approaching OBJ (distance and direction). UAV view of OBJ from flyover.

Alternatives:
1. The best assault direction would be from the north
2. The best assault direction would be from the west
3. The best assault direction would be from the south

Feedback:
<u>In response to Answer 1</u>. Your answer is correct. However, the close proximity of the buildings may prohibit the ICVs from entering the compound and providing the desired support.
<u>In response to Answer 2</u>. Reassess your answer. The overlay is showing that avenue of approach is heavily protected.
<u>In response to Answer 3</u>. Your answer is correct. An assault element could easily breach the southern portion of the fence and assault the objective with little obstructions.

Supporting Graphic:

Objective Raven FOV



Q 3-2

Question:
You do not detect many enemies patrolling the compound, what do you do next?

Sensor Information:
The UAV assets see the compound and it appears empty. The UGS nodes detect heavy seismic activity in the south. A SUGV is looking into a large hole on the south of the OBJ.

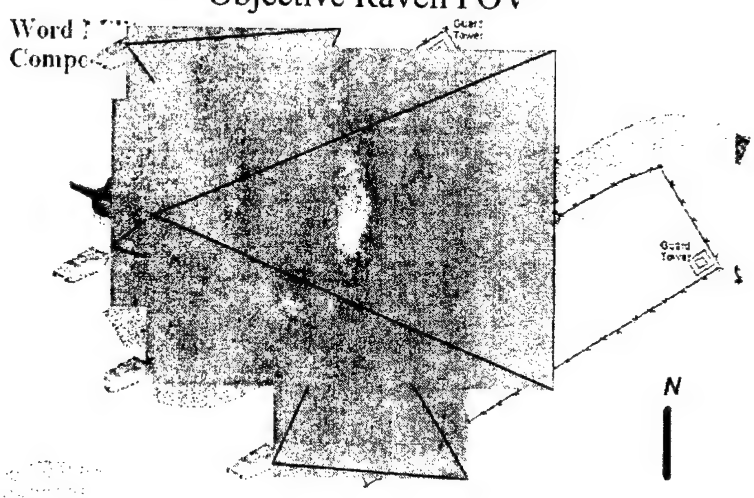
Alternatives:

1. Continue assault of the objective and hope it is empty
2. Stop assault and report to higher
3. Task SUGV to investigate the whole and task other vehicles with seismic ability to move to the activity spotted by the UGS node in the south.

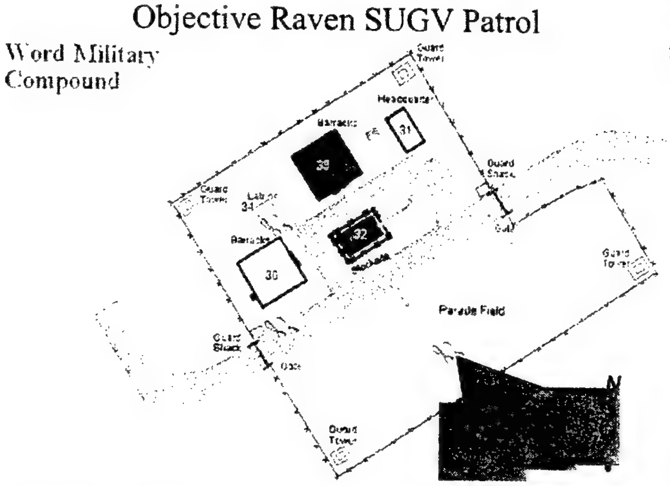
Feedback:
In response to Answer 1. This answer is incorrect. You have not looked at your sensor activities, if you had you would have seen significant seismic activity to the south of the objective, along with a SUGV looking at a large whole in the area. All of this information would point to a possible tunnel complex.
In response to Answer 2. This answer is not the best answer. While a report should be sent to higher, you should not stop the assault since you have the tools available to you to investigate and reformulate your plan.
In response to Answer 3. This is the best answer.

Supporting Graphics:

Objective Raven FOV



Objective Raven SUGV Patrol



Q 3-3

Question:
Intelligence has been handed down to you, before the assault, that the enemy has an extensive tunnel system, how would you proceed?

Sensor Information:
The UGS nodes all around the OBJ have detected seismic activity. The Class III UAV has been allotted to be used, and it has the ability to detect subterranean tunnels. A SUGV in the south has identified a large hole in the ground. Similarly, a SUGV has detected a large hole to the east.

Alternatives:
1. Task SUGV in the east to move into the hole
2. Task the Class III UAV to conduct a scan of the OBJ and destroy the access points
3. Task the Class III UAV to conduct a scan of the OBJ and have the SUGV move to the access points and guard them

Feedback:
In response to Answer 1. OK. While this answer is not wrong it is certainly not the best answer because it does not allow you to develop a full picture of what is happening in the area.
In response to Answer 2. While this will seal off the access point to the tunnel system, you will not be able to achieve your mission goal of securing the CLF leadership.
In response to Answer 3. Given all of the information this is the best course of action.

Q 4

Question:
The weapon squad is positioned to the north of the Objective. From where will you have 1st squad assault?

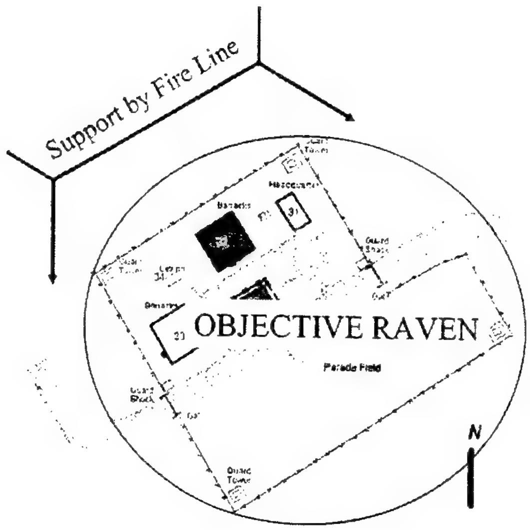
Sensor Information:
3d terrain map is displayed with Weapons Squad located on it and all the space they can see and cover. ICVs have snap shot photos from their assault positions to the west. UAVs are in flight paths over the OBJ.

Alternatives:
1. Assault from east side of the objective
2. Assault through the gate on the west side of the OBJ
3. Assault through west side by the watchtower.

Feedback:
In response to Answer 1. This is not the best place to assault from due to the barricades on that assault route.
In response to Answer 2. This is not the best place to assault from due to the barricades on that assault route.

In response to Answer 3. This is the best assault path.

Supporting Graphic:



Q 4-1

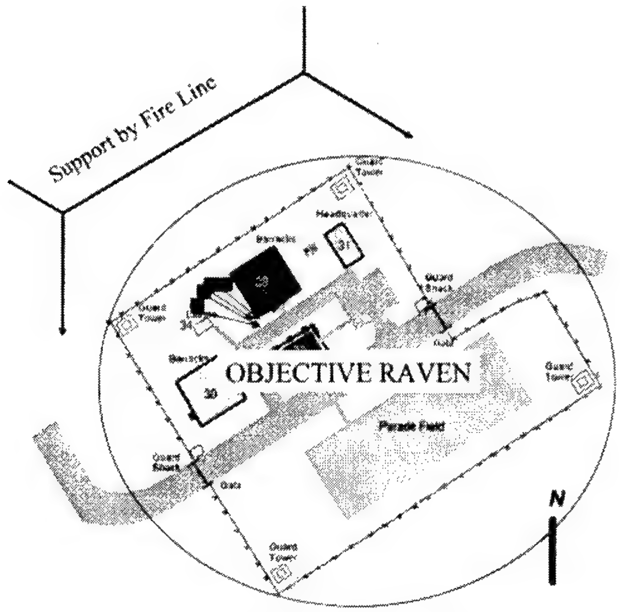
Question:
The support by fire line engaged a team of four men who then disappeared. How would you change the assault plan?

Sensor Information:
The ICVs have started the assault (from the west) and their visual sensors have identified some lumps in the terrain between buildings. UAVs are still in orbit and no other sensors have visual information on the OBJ. The subject would then have to gather information from his ICV that may be his initial source of data and then query other sensors (in this case UAVs) to supplement the information he is getting.

Alternatives:
1. No change.
2. Request that 1st Squad use an indirect weapon to destroy the targets and then reassess the situation.
3. Request 2nd Squad directly engage the targets and have 1st Squad move to cover 2nd Squads movement

Feedback:
In response to Answer 1. This answer is incorrect. If you do not reassess the plan and continue on the current assault plan, one of your squads could be ambushed and destroyed.
In response to Answer 2. This is a good answer. Target is located at XYZ.
In response to Answer 3. This is the best answer. Target is located at ABC.

Supporting Graphic:



Q 4-2

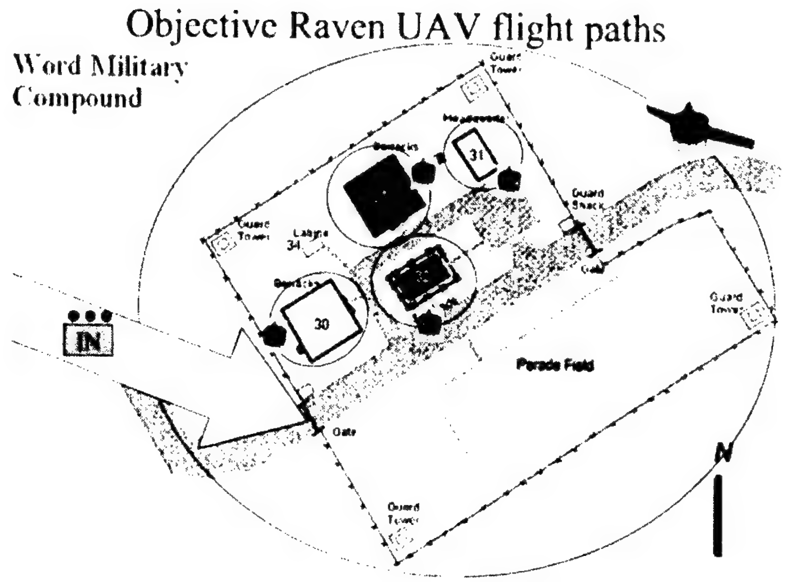
Question:
Where would you place the weapons squad to cover the assaulting force?

Sensor Information:
UAVs are flying in orbit in their flight paths. All buildings are visible from the top down and the terrain has been mapped. Higher HQ has already provided you with a 3D and 2D map of the area of operations (AO). See overlay with pictures from UAVs.

Alternatives:
1. To the north of the OBJ
2. To the west
3. To the south

Feedback:
<u>In response to Answer 1</u>. Answer is OK
<u>In response to Answer 2</u>. This answer is not correct. This would have the weapon squad firing across the objective into the assaulting force. Reassess the question.
<u>In response to Answer 3</u>. Answer is Ok.

Supporting Graphic:



Q 4-3

Question:
2nd Squad is assaulting from the North West corner of the objective, however they cannot see beyond the fence, how would you continue the assault?

Sensor Information:
The ICV can see from the west to the east no further than the first set of buildings. The Mule #1 can see the north side only to the first buildings, and Mule #2 can see the south to the buildings. The SUGVs are shown entering the compound one from each direction. The SUGVs are only able to see about 15 degree FOV.

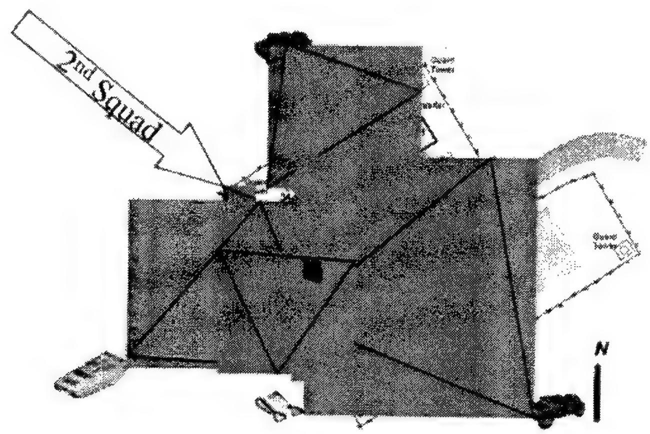
Alternatives:

1. Do not change the assault
2. The ARV has a missile that can be used and is tasked to take it out. The maneuver stays the same.
3. The initial assault will not change. 3rd Squad will not be move until authorized.

Feedback:
In response to Answer 1. This is incorrect. By not reassessing the assault and utilizing your assets to provide your squads the ability to see the objective as to not assault blindly may result in catastrophic events.
In response to Answer 2. While this answer is correct, before the assault can stay the same you must reassess the battlefield utilizing all of your sensors. The ICV and the SUGV in the west have identified a camouflaged bunker next the first set of buildings. The sensors are picking up everything until the first set of buildings.

In response to Answer 3. This is the best answer due to the information displayed by the sensors. The SUGV on the West side of the OBJ has detected a machine gun in a building covering the south west corner to the south east corner.

Supporting Graphic:



Q 5

Question:
Weapon Squad is taking sniper fire from one of the buildings, how will you engage the threat?

Sensor Information:
3D map with location of Weapons Squad and their line of sight (LOS) and the location of the entire platoon. The UAV flying around the building has a picture of the enemy on the roof. The Mule #1 has acoustic sensor that has detected multiple gunshots from that building.

Alternatives:

1. Task ARV to hit building with missile.
2. Call for fire on the building from a Battalion asset
3. Have 1st Squad assault the building and clear the rooftop.

Feedback:
In response to Answer 1. This answer is wrong. Since the mission is to retrieve intelligence and CLF leadership personnel, it might destroy the building, thus destroying intelligence or the leadership personnel. Reassess your answer.
In response to Answer 2. This answer is wrong. Since the mission is to retrieve intelligence and CLF leadership personnel, it might destroy the building, thus destroying intelligence or the leadership personnel. Reassess your answer.
In response to Answer 3. Correct Answer.

Q 5-1

Question:
The TF commander has given the company a Class III UAV with an air to surface missile, and the Company commander wants a suggestion on how he should use it. What is your suggestion?

Sensor Information:
The Company UAV is following an incoming convoy threat. There are snipers on the roof of a building as seen from a UAV. The Mule #1 has detected a large crowd on the parade field.

Alternatives:
1. On the crowd
2. On the convoy
3. On the building

Feedback:
In response to Answer 1. Incorrect answer. The correct way to deal with the crowd is with non-lethal munitions. Reassess your answer.
In response to Answer 2. Correct answer.
In response to Answer 3. Incorrect answer. Since the mission is to retrieve intelligence and CLF leadership personnel, it might destroy the building, thus destroying intelligence or the leadership personnel. Reassess your answer.

Q 5-1-1

Question:
The TF Commander decides there is a more pressing target to destroy and retasks the Class III UAV. How would you deal with the convoy?

Alternatives:
1. Call for fire.
2. Task a UAV to track it and once it got close enough use the ARV and ICVs to ambush it.
3. Nothing, because you will be done with the mission prior to their arrival.

Feedback:
In response to Answer 1. Correct
In response to Answer 2. Incorrect since the UAV does not have the range nor would you want to ambush the convoy with the limited firepower of the ICV. The correct response would be to call for fire on the convoy.
In response to Answer 3. Incorrect since the timeline may change and you would not want them to get close enough to engage you. The best answer would be to call for indirect fire.

Q 5-1-2

Question:
(From the information displayed in your sensor menus) What action would you take at the parade field?
Sensor Information:
Sensor menu screen has pictures from the UAVs. If the trainee picks the UAV to display the pictures, they will display an aerial photo of a crowd massing on the parade field.

Alternatives:
1. Take no action, continue with plan.
2. Engage the enemy Soldiers with direct fire weapons.
3. Engage the crowd with non-lethal munitions.

Feedback:
In response to Answer 1. Incorrect. Redo the question.
In response to Answer 2. Incorrect. There are no visible weapons and they happen to be prisoners that the CLF has released into the compound to distract the assaulting force.
In response to Answer 3. Correct. The crowd happens to be prisoners that the CLF has been holding for quite some time. However, you were unable to assess this prior to the assault. The non-lethal munitions would render them harmless to the assaulting force and would allow you to secure them once the mission is complete.

Q 5-2

Question:
You deployed the Class I UAV and it was shot down by enemy small arms fire.
This just happened before 2nd squad is about to move to the building around which it was flying. How do you change the assault plan?

Sensor Information:
Weapons squad is placing known enemy locations on the map from what they see in their position. The Mule #1 is scanning the north side of the objective. Mule #2 is scanning the south side of the OBJ. The ARV is scanning the middle of the OBJ.

Alternatives:
1. No change is required
2. Upon query from Wpn Sqd and Mule #1 there seems to be movement on the roof. Therefore, the ARV will provide a team cover during their movement across the danger area. If they are engaged, another team will engage the target utilizing an indirect fire asset.
3. The ICV does not see anything in the area and the Mule #2 does not identify targets that could engage the assault of 2nd squad. However, a SUGV has identified an enemy on the ground floor of the next building. Therefore, the Squad should move and assault from the north side rather than the west side of the building.

Feedback:

In response to Answer 1. Incorrect. Without the UAV flying in orbit to feed information to the squad and platoon, once they start the assault they are likely to miss important pieces of information. Reassess your answer.

In response to Answer 2. Correct answer.

In response to Answer 3. Correct, however it may not account for how the UAV was shot down, and the threat could still be there. Therefore, you should have used the UAVs last sensor transition to pinpoint the enemy who shot it down.

Q 5-3

Question:

One of the Platoon Mules has hit a land mine is not responding, and part of your plan was for the Mule to provide roving guard to the south. How do you compensate for this and how do you map the minefield?

Sensor Information:

The UGS to the north are shown on an overlay still covering the north. There is no information from the Mule except a red icon depicting that it is no longer functioning. The UAVs are all still in their correct orbit and see the OBJ from the sky. A SUGV that was with the Mule is all right.

Alternatives:

1. The UGS can cover the area
2. The UGS can cover the area, and retask a UAV to map the minefield
3. Use the SUGV to detect mines and provide the sensor coverage needed.

Feedback:

In response to Answer 1. Correct. You would also want to report to higher to try to obtain a Class III UAV to conduct a reconnaissance and mapping of the minefield. You have no assets that can see into the minefield.

In response to Answer 2. Wrong. None of the UAVs in your control is able to perform that function.

In response to Answer 3. Correct, however the speed at which this vehicle can conduct mine detection activities is very slow.

Q 6

Question:

The UGS node in the south is not responding, and your mapping of the area has shown tunnels, do you investigate?

Sensor Information:

UGS nodes are detecting a lot of seismic activity in the south. The Mule #2 has captured video of a lot of movement in the area. A UAV has not been able to spot anything on a flyover. Display the UGS vitals before contact was lost.

Alternatives:

1. No investigation is needed.
2. Investigation is needed. 3rd Squad will conduct human investigation.
3. Investigation is needed. A nearby SUGV will investigate along with a Mule.

Feedback:

In response to Answer 1. Incorrect. You would need to reassess the UGSs sensors prior to it going off line. The battery light came on shortly before we lost contact

In response to Answer 2. Incorrect. 3rd Squad is key to success of the assault and if it were taken out of the battle to investigate, you would have to find ways to cover their objectives. The better way would be to retask a UAV to fly a pattern covering its target and that of the UGS and supplement it by tasking a SUGV to move to fill the UGS place.

In response to Answer 3. Correct.

Q 6-1

Question:

1st and 2nd squads UAVs are not responding or sending back information, do you proceed with the mission?

Sensor Information:

UAV 3 shows a picture with the area around a single building with a couple of enemy in the area. A Mule shows a crowd outside a building around a smoldering heap. UAV 4 alarms are going off signaling an attack on it.

Alternatives:

No, we are not prepared to attack such a force

Yes, but the plan needs to be modified do to the large number of enemy.

Yes, but no modification to the plan is needed

Feedback:

In response to Answer 1. Incorrect. Redo question over again.

In response to Answer 2. Correct.

In response to Answer 3. Incorrect. Do to the UAVs which have been lost to enemy fire there are no sensors currently in their place, therefore retasking a MULE or SUGV to cover the area would assist the assaulting force.

Q 6-2

Question:

1st Squad is receiving sniper fire, do you move to point A, B or C (TBD later)?

Sensor Information:
All UAVs are flying in their particular orbit and communications are available to all Platoon level UAVs. The Mule #1 is located in the southern portion of the OBJ and its acoustic sensors are responding properly. Mule #2 is in the northern portion of the OBJ and its acoustic sensors are responding properly. The UGS nodes are all in place (covering each quadrant of the OBJ). See overlay with Mules, UAVs and UGS in position and triangulating the position where the sound came from. May also have other noises which are captured on this slide to cause a not so obvious answer, subject will have to related overlay information to who in the platoon is receiving the fires.

Alternatives:
1. A
2. B
3. C

Feedback:
In response to Answer 1. Correct. UAV 1 and Mule 2 have detect the sniper at location X. Therefore this is the only safe path.
In response to Answer 2. Incorrect. UAV 1 and Mule 1 have detected the sniper at location Y. Therefore this would be the only safe path.
In response to Answer 3. Incorrect. UAV 4, Mule 2 and UGS node 2 have detected a threat at Z. Therefore this would be the only safe path.

Q 6-3

Question:
Intelligence reports have reinforcements moving toward you area of operations, how would you keep informed of their movements?

Sensor Information:
Picture showing Class III UAV looking down at ground and seeing a convoy heading toward the compound.

Alternatives:
1. Ask TF commander to use Class III UAV to track and send you reports
2. Re-task a Platoon UAV to move to the convoys' location and over watch it.
3. Request the Company commander task the Class II UAV to move to the convoys' location and over watch it

Feedback:
In response to Answer 1. Correct, however it would also be beneficial to plan another option.
In response to Answer 2. Incorrect. The Class I UAV does not have the range or on station time left to complete that task.
In response to Answer 3. Correct. However if this does not happen you will have to retask your platoon UAVs to cover the convoy when it gets closer.